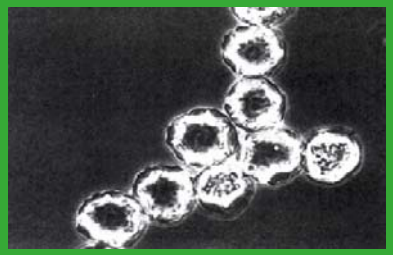
Health Effects of *Acanthamoeba* (A-kanth-a-ME-buh) spp. and Its Potential for Waterborne Transmission



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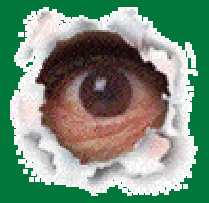
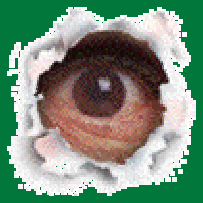
Overview





- The statutory requirement for EPA's CCL
- The criteria for regulatory determination by EPA
- Significance of the *Acanthamoeba* study and it's relevance to EPA's mission
- Contribution made to science & recognition outside EPA
- What is *Acanthamoeba?*
- Occurrence and Health effects
  - keratitis and contact lens association
  - brain encephalitis (GAE)and immune deficient individuals
- Risk Factors and Population at risk
- Diagnosis and treatment

Acanthamoeba Outreach Products

STAA 2004 Award Winning Paper

Authors: Nena Nwachuku and Charles P. Gerba, 2004.

Paper Title ‘’ Health effects of *Acanthamoeb*a and it’s potential for waterborne transmission”

Journal: Reviews of Environmental Contamination and Toxicology (Springer-Verlag, New York)
Vol 180:93-131

Paper was based on the EPA “Health Effects Support Document” EPA-822-R-03-012, written by Dr. Nwachuku and Dr. Gerba. (3 internal review cycles and external peer reviews)

Significance / Impact of the study and it's relevance to EPA's mission

The health effects study (EPA-822-R-03-012) provides the scientific basis and helped EPA administrator to make the "Do Not Regulate" regulatory determination decision for the agency on *Acanthamoeba* on the CCL (federal register 68/139)

The work reported in the nominated paper currently provides the most up to date information there is on all aspects of public health risk and occurrence of *Acanthamoeba* in water.
EPA worked with CDC, FDA and contact lens council , Drs. Martinez and Visvesvera (leaders in the field), in obtaining the most current data on *Acanthamoeba.*

Recognition of contribution outside EPA

- American Society of Microbiology (ASM), selected study abstract for presentation at the 2002 National meeting at Salt Lake city, Utah

- ASM selected and highlighted this EPA presentation in the ASM press room and ASM web site for the 2002 Annual meeting in Salt Lake city

- ASM identified the abstract and requested summary write up from EPA for distribution to journalists covering the 2002 ASM meeting.

- Positive stakeholder comments from AWWA to EPA

- **Constant reprint requests globally and numerous calls from general public on *Acanthamoeba***

Statutory Requirements for EPA's Contaminant Candidate List (CCL)

- **1996 SDWA Amendments (Section 1412(b)1(A) require EPA to :**
- **Publish a CCL list every 5 years**
- **Make regulatory determinations on at least 5 contaminants**
- **Use 3 criteria to determine whether to regulate**

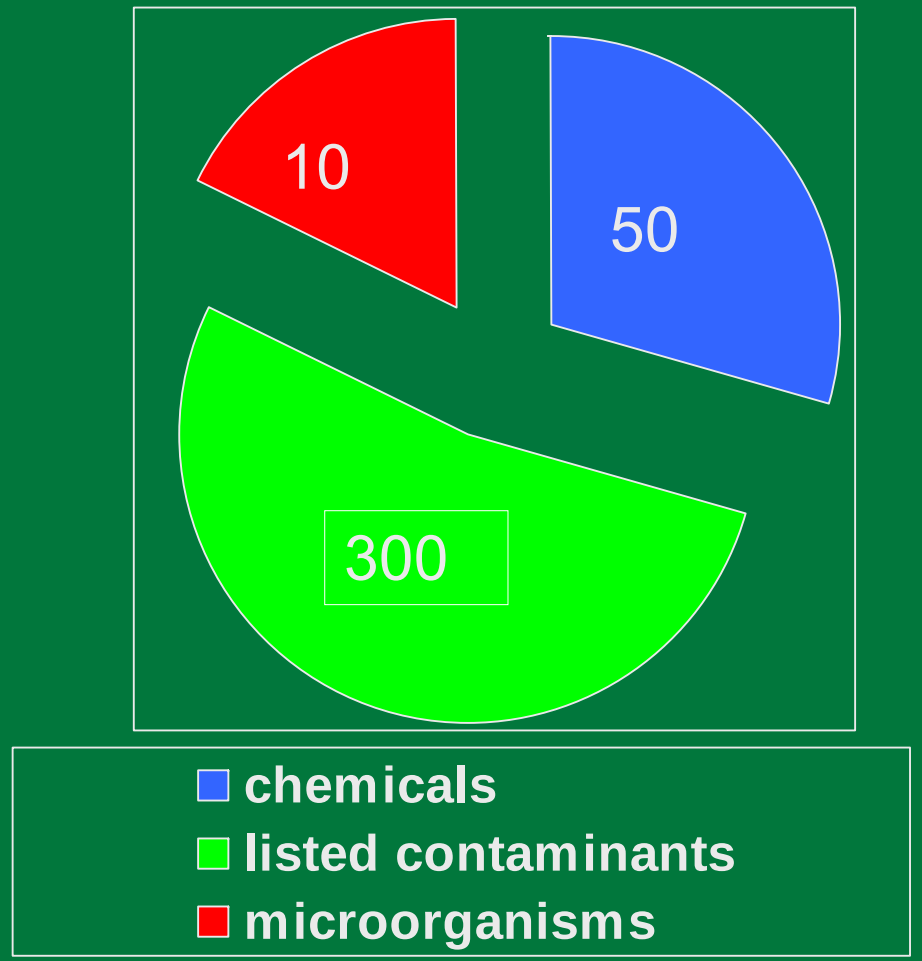
Regulatory Determination Criteria for CCL Contaminants

- Contaminant may have an adverse effect on human health.
- Contaminant is known to occur or there is substantial likelihood that the contaminant will occur, in PWS with a frequency and at levels of public health concern.
- In the sole judgment of the administrator, regulation of such a contaminant presents a meaningful opportunity for health risk reduction for persons served by PWS

Contaminant Candidate List -1

Published final FR on March 2, 1998

- Listed 60 contaminants
- 50 chemicals out of 270 possible contaminants
- Listed 10 microbes out of 30 (expert microbiologist workshops)
- Selection based on occurrence and health effects.



Microbial Pathogens on the EPA's Drinking Water CCL (1)

- Protozoa
  - Acanthamoeba
  - Microsporidia
- Viruses
  - Adenovirus
  - Coxsackievirus
  - Echovirus
  - Norovirus (Norwalk) and other calicivirus
- Bacteria
  - Aeromonas hydrophila
  - Helicobacter pylori
  - Mycobacterium avium intracellulare (MAC)
- Bluegreen Algae • Cyanobacteria and toxins

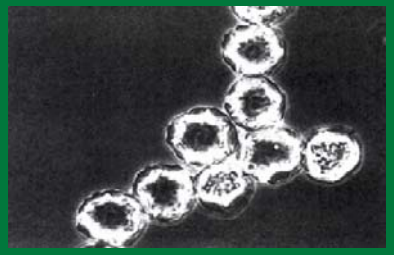
Regulatory Determination on CCL-1

Published final FR on July 18, 2003

Determination made on one microbe and 8 chemicals out of the 60 contaminants on CCL-1

✓ ***Acanthamoeba***	Hexachlorobutadiene	Naphthalene
Aldrin	Manganese	Sodium
Dieldrin	**Metribuzin**	**Sulfate**

What is *Acanthamoeba* (A-kanth-a-ME-buh)?



- **Free living amoeba, widespread in environment, soil, water, brackish water, sewage, biosolid.**
- **20 species in the genus .**
- **few are capable of causing disease in humans.**
- **classified in 3 groups based on cyst morphology**
- **Feeds on bacteria-can have symbiotic relationship**
- **Simple life cycle, cyst and trophozoite.**
- Associated with contact lens infection

Occurrence of *Acanthamoeba*

Source	Reference
Water fountains	Crespo et al. 1990
Tap water	Rivera et al. 1979
Bottled water	Rivera et al. 1981
Hospital tap water	Rohr et al. 1998
Eye wash stations	Tyndall et al. 1987
Freshwater ponds	John and Howard 1995
Thermal water	DeJonckheere 1979; Dive et al. 1982
Well water	Jones et al. 1975
Physiotherapy tubs	Penas-Ares et al. 1994
Aquaria	DeJonckheere 1979
Municipal sewage	Singh and Das 1972
Ocean sewage dump site	Sawyer et al. 1982
House dust	Yamaura et al. 1993
Garden soil	Singh 1952
Sand box	Yamaura et al. 1993
Garden vegetables	Rude et al. 1984
Fish	Taylor 1977
Air conditioner	Walker et al. 1986

Acanthamoeba occurrence in water

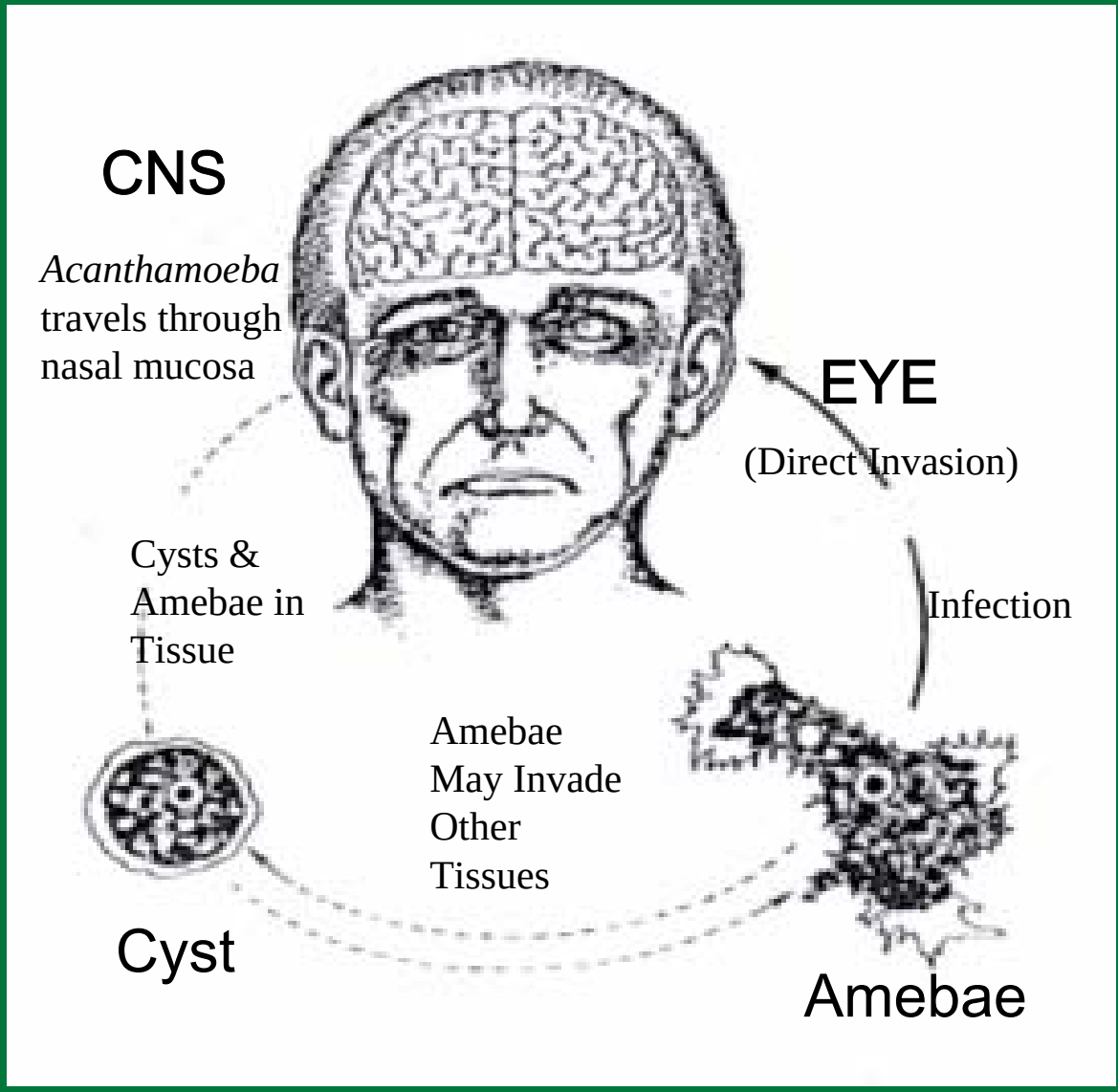
- Common in aquatic environment
- Detected in 50% of surface water in recreational water (Detterline and Wilhelm(1991)
- Shown to be transmitted through hot tubs, bottled water and tap water (Nwachuku and Gerba, 2004)
- Capable of growing in distribution systems after conventional treatment (Nwachuku and Gerba, 2004)

Health Effects of *Acanthamoeba*

- Two Major Illnesses (Granulomatous amoebic encephalitis (GAE) , Acanthamoeba keratitis (AK) ,

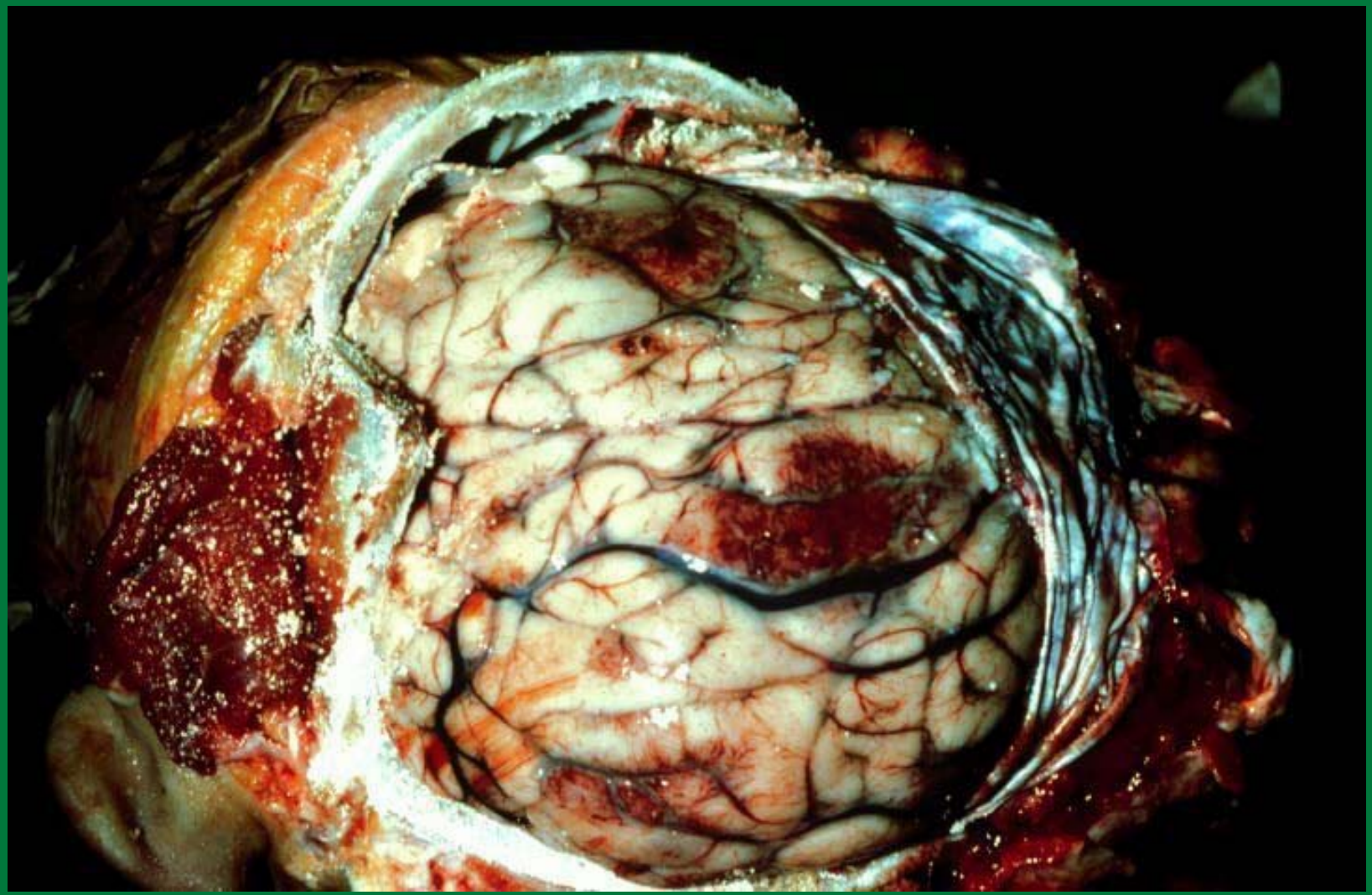
Features	GAE	AK
Predisposing Factors	Immunodeficiency AIDS, debilitating illness	Healthy, corneal trauma contaminated contact
Epidemiology	worldwide	worldwide
Portals of Entry	Skin, Lungs, nose	Corneal abrasion
Incubation	Weeks to months	Days
Prognosis	Almost always fatal	Good if properly treated

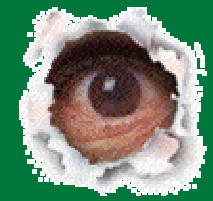
Life Cycle of *Acanthamoeba* spp and Human Infection

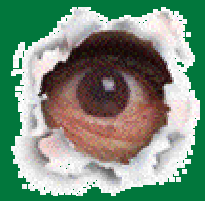


Acanthamoeba Infected Brain , (GAE)

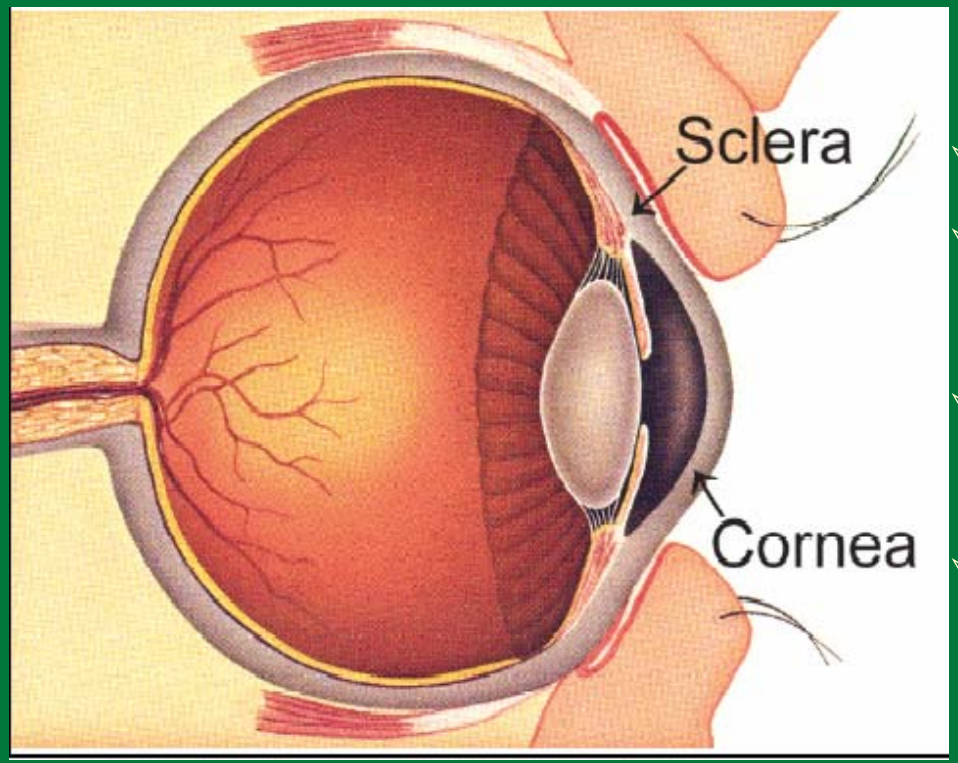
(Courtesy of Dr. Julio Martinez University of Pittsburgh)







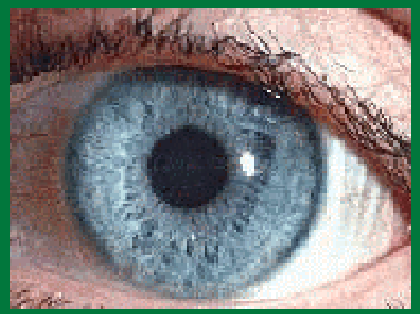
Natural Defense Mechanism



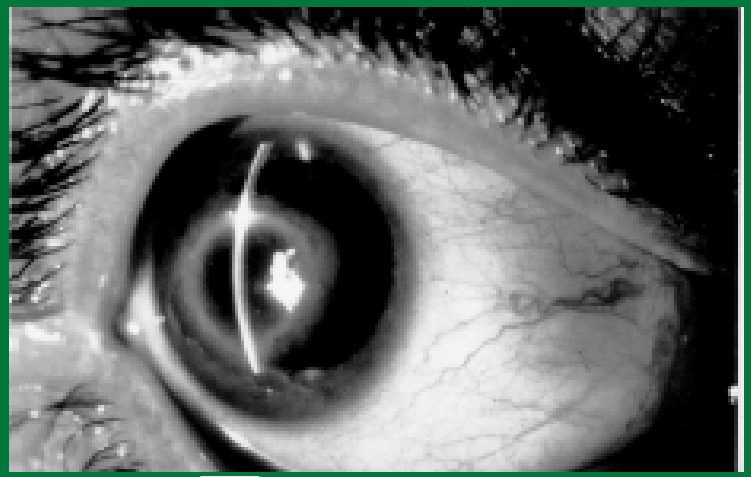
- Cornea is target site
- Warm, moist and exposed to environment.
- Constantly challenged by microbes.
- Protected by natural defense mechanism in the tear film Lysozyme, Lactoferrin, Secretory IGA, and the blinking of the eye.

Acanthamoeba infected Eye

Normal EYE



Diseased Eye
(diagnostic concentric ring)



Progressed stage of disease

Contact Lens Associated Pathogens

- Several microbes can cause keratitis
- Most common ones are*: Pseudomonas aeruginosa*, *Candida albicans, Aspergillus, Herpes,* and *Acanthamoeba*
- Clinicians have mistaken *Acanthamoeba* keratitis for herpetic, fungal and bacterial keratitis
- *Acanthamoeba* is the only microbe that can cause the most devastating and potentially blinding infection in humans

Population at Risk

- Contact Lens is a medical device regulated by FDA
- Over 34 million contact lens wearers in the U.S.
- Over 71 million worldwide
- Age range is from 8 years to over 60 years
- Today most people (85%) of them wear soft contact lens with 35-80% water content
- Most use daily wear
- 25% wear extended wear

Risk Factors Associated with *Acanthamoeba* Keratitis

Risk Factor	% Ak cases
Wore contact lenses	85
Wore daily wear	56
Wore Extended wear	19
History of corneal trauma	26
History of exposure to contaminated tapwater	25

Risk Factors for *Acanthamoeba* Keratitis in contact lens Wearers

Risk Factor

- Use of tapwater to wet or store lenses
- Use of bottle water to wet or store lenses
- Use of non-sterile solutions to wet/ store lenses
- Wearing contacts during swimming
- Wearing lenses in hot tubs
- Lens swapping
- Wetting lenses with saliva

Characteristics ,Symptoms Diagnosis, And Treatment of AK

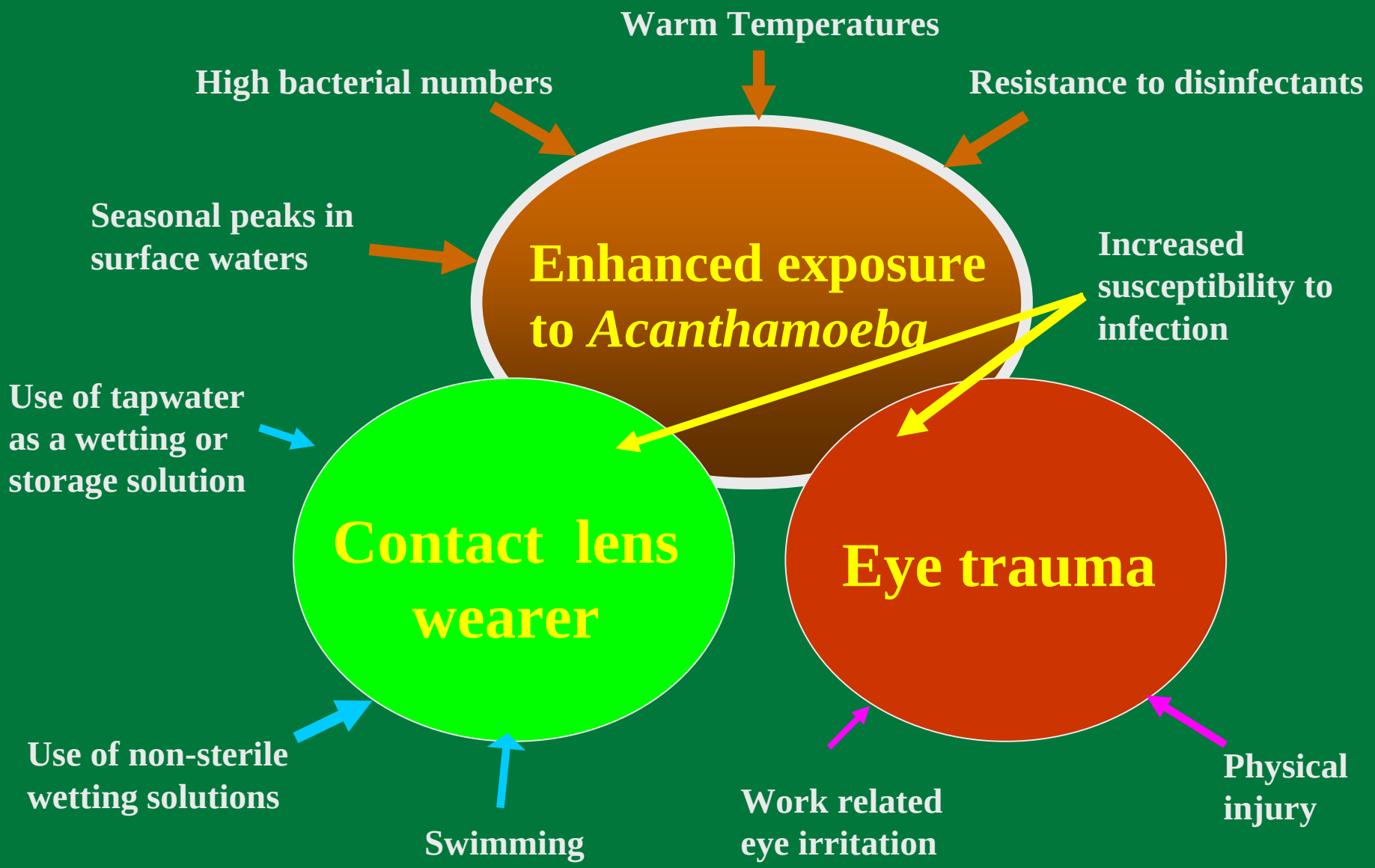
- Young, healthy individual and wears soft contact lens
- Non-sterile solution user
- Eye trauma
- Usually one eye affected
- Extreme eye pain
- Corneal breakdown
- Late in infection, a corneal ring infiltrate is seen
- A combination of treatment topical ointments

(ex. Brolene)

Types of Contact Lenses

- Cosmetic colored, and theatrical lenses are in high demand *among teenagers* (Contact Lens council, 2000)

Conditions That Increase Exposure to *Acanthamoeba*



EPA's decision on *Acanthamoeba*

The critical control point identified for *A*k in contact lens wearers is personal hygiene ***not*** drinking water. Therefore there is no meaningful opportunity for health risk reduction for the general population served by PWS by regulating *Acanthamoeba*.

Acanthamoeba eye infections result from the use of home made solutions, contaminated tap water to rinse, store contact lenses, lens swapping and wearing contact lenses during swimming.

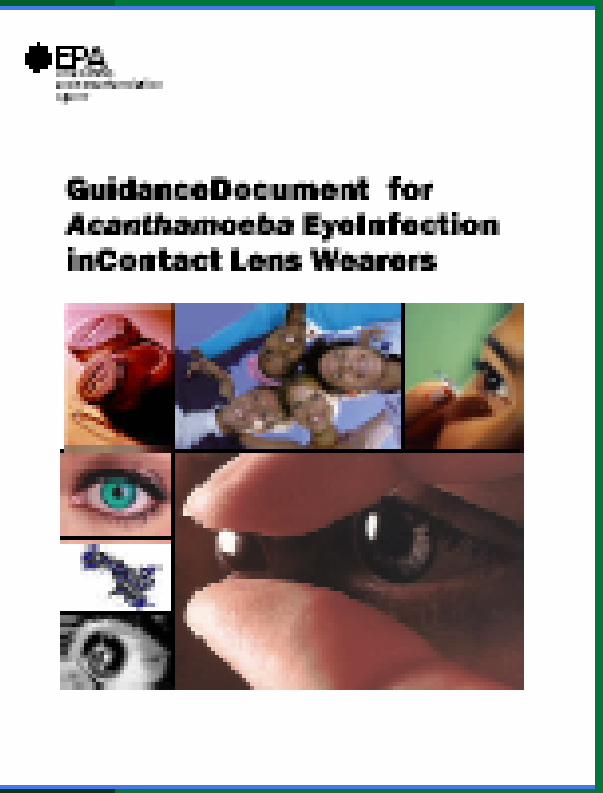
The incidence of GAE due to *Acanthamoeba* is very low.

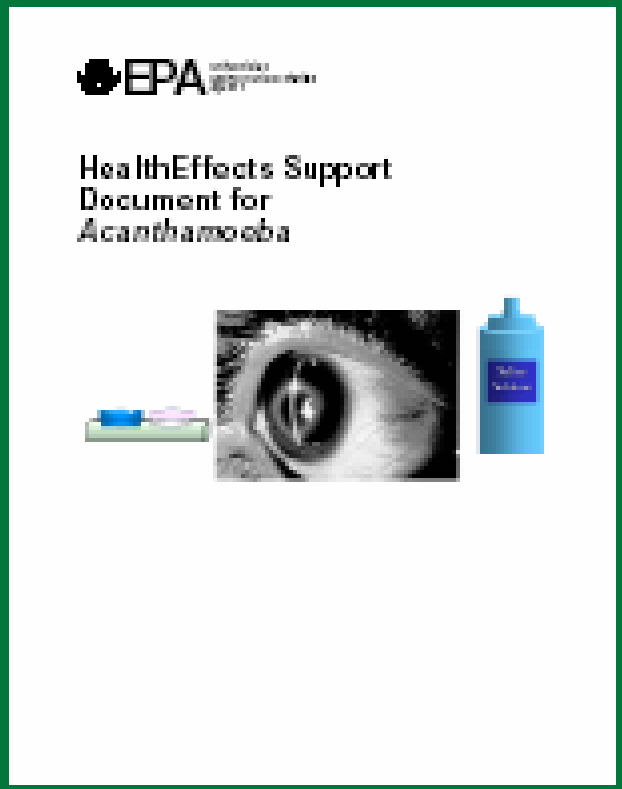
If Consumers adhere to lens manufacturer's instructions, for storage and rinsing with sterile solutions *Acanthamoeba* keratitis will be reduced.

For public health protection, EPA has developed a guidance and outreach products for contact lens wearers and health care providers.

Acanthamoeba Outreach Products

Documents





Fact Sheets

Brochures

Acknowledgements

- Dr. Charles P. Gerba, University of Arizona
- Science Advisory Board
- STAA-ORD for this Prestigious Award